REMARKS

In paragraphs 4-7 of the Office Action dated June 22, 2005, Claims 1-27 were rejected under 35 U.S.C. 103(a) as being unpatentable over Proulx (U.S. Pat. 5,807,462) ("Proulx '462") in view of Groff et al. (U.S. Pat. 4,288,463) ("Groff") and Mize et al. (U.S. Pat. 4,186,239) ("Mize"). The Applicant respectfully traverses the rejections and submits that the claims are patentable over the cited art for the reasons set forth below.

The present invention is directed to a continuous process for forming a noise attenuating flexible cutting line for use in rotary vegetation trimmers. The high pitch whine generated by conventional nylon cutting line in these high rpm trimmers travels quite far and is objectionable to many people who are not even in the immediate proximity of the rotating trimmer head. As a result, there has developed a growing need for noise attenuating cutting line. For such line to be commercially viable, however, it must be economical to produce. Applicants' line achieves both of these goals.

The line of the present invention provides superior noise attenuation in its preferred embodiments through a novel twisted configuration in which two or more generally V-shaped troughs are formed that extend helically along and about the longitudinal axis of the line. In the most preferred configuration, two directly opposed V-shaped troughs are employed such that the line in cross-section (see, *e.g.*, Figs. 3B and 4) has the appearance of two overlapping circles with the opposed

troughs laying on the minor diameter of the line which is perpendicular to the line's major diameter. Further, the line preferably defines at least 15, and more preferably at least 20, twists per linear foot. The resultant line configuration provides substantial noise attenuation.

To create such a line configuration, the Applicant extrudes two cylindrical strands of a monofilament polymer material and twists the strands about each other while in a molten condition such that the strands bond together in fused seams that extend along the bottoms of the V-shaped troughs. This is achieved by a novel forming process wherein the molten nylon copolymer material is extruded through a die that defines a pair of preferably circular die holes. As the molten material is extruded through the die, the die is rotated about its central axis at speeds from about 750 to 2500 rpm to effect the desired tight twist in the line.

To provide the necessary flexibility and durability in the resultant cutting line, it is necessary that the formed line, following extrusion and cooling undergo a reheating and stretching step during which the line is stretched approximately three times its original length. This is true of all extruded cutting line, regardless of its shape. As a result, however, the number of twists per linear foot in this new line is reduced by a factor of about three. However, Applicant has found that, at least within certain ranges, increasing the number of twists in the line per foot, increases the noise attenuation. Applicant' s new process of twisting together two separate extruding molten strands allows for a tighter twist in the

final product, and thus a quieter line than could be produced by twisting a single strand about its own axis. This process also allows the line to be formed in a continuous on-line process, as is the case with conventional nylon cutting line, thereby avoiding the need for separate and costly secondary processing (*i.e.*, carving or twisting the line after it is extruded). The elimination of the need for such secondary processing significantly reduces the cost of manufacture.

Claims 1-27 were rejected under § 103(a) in view of Proulx '462, Groff and Mize. While each of the cited prior art patents is directed to a very different purpose and operation, the newly cited Fogle patent (no. 6,434,837) is directed to noise attenuation. However, neither Fogle nor any of the other prior art teachings even suggest that flexible trimmer line, let along noise attenuating line, can be formed by twisting together two strands of molten material to form a single length of cutting line. The inapplicability of the three cited patents and Fogle will be analyzed in turn.

Proulx '462

While Applicants' earlier Proulx '462 patent teaches a process for forming flexible cutting line, that process forms a very different product and one that is not at all related to noise attenuation. Just as the products are quite different in their configuration and purpose, the processes for forming them are also different.

Proulx '462 discloses a process for forming cutting line that solves the problem of line tangle within the trimmer head housing. Because the head of a trimmer typically employs at least two separate cutting lines, care must be taken in winding the lines about the common spool to prevent the lines from crossing over one another or otherwise tangling within the housing. This problem was particularly acute in automatic and bump-feed type heads in which fresh line is paid out the housing during use by centrifugal force without having to stop the trimmer, open the housing and manually pull fresh line from the interior spool. Proulx '462 sought to make a line comprised of two monofilament strands joined together in a side by side relationship along a thin, readily severable bond. The severable bond or weld was essential to keep the two lines together in a parallel disposition within the housing so that they could not cross over one another and tangle. Yet, the two bonded strands or lines could be readily separated proximate their extended ends so that they could individually project through opposing guides in the side of the housing. To accomplish this task the weld that joined together the two parallel lines had to be quite delicate for use on automatic and bump feed heads or the lines would not separate and the trimmer head would jam.

The present invention, unlike that disclosed in Applicants' Proulx '462 patent seeks to form a cutting line in such a way as to attenuate noise. As a result, the severability quality, which was of key importance in Proulx '462, is of no consequence here. In contrast to a double-strand filament line with a severable

weld, the strands of the present invention are permanently welded together and twisted about each other. Accordingly, there is nothing in Proulx '462 that teaches or even suggest that cutting line can be configured so as to be noise attenuating by twisting two strands of molten material together as claimed. Nor does Proulx '462 even teach that any particular configuration of cutting line by twisting together two strands of molten material. In fact, Proulx '462 teaches away from twisting because doing so would necessarily tangle or fuse together the individual lines, which is exactly what Proulx '462 was trying to avoid. Further, any twisting of the line formed by the Proulx '462 process would break the severable weld which the process is designed to create.

<u>Mize</u>

The Office Action cites Mize for the motivation to form a cutting line with the novel twisted configuration. However, upon closer examination of that patent, it is clear that Mize is concerned only with fiber fibrillation, not noise attenuation. In addition, as explained in the accompanying declaration of Richard Proulx the only twisting of cutting line in Mize is accomplished as a secondary process after the line has been formed (extruded) and indented. As such, Mize does not teach the novel method of twisting together two molten strands in such a way so as to form a single line that attenuates noise while obviating the need for costly secondary processing.

The cited Mize patent teaches a monofilament line having various irregular configurations which are distorted by a secondary cold-forming or swedging process to form a series of axially-spaced indentation (identified by the number 40 in the drawings) to create "axial fracture points." Those fracture points purportedly allow pieces of the line to break off and reduce the tendency of the end or the terminal portion of the filament to fibrillate, as shown in Figure 6 of Mize, which adversely affects the cutting quality of the line. Fibrillation and the creation of the fraction points disclosed in Mize have nothing whatsoever to do with Applicants' invention which is directed to noise attenuation and, more particularly, to the formation of noise attenuating trimmer line by twisting together strands of extruding molten material.

Mize shows a twisted and indented line having a "four-lobe" configuration (Figure 11) and an indented line comprised of two adjacent circular strands, possibly joined by a short, thin webbing (Figure 7). There is no discussion in Mize as to how these lines are formed. We are only told that the sets or series of indentations 40 are applied in a secondary operation. A number of facts, however, are readily apparent which also bear on the relevance of the lines shown in Figures 7 and 11 of Mize. First, the twisting of the cutting line shown in Figure 11, like the indentations, is achieved in a secondary process. As explained in the accompanying Declaration of one of the co-inventors in the present application, Richard A. Proulx, the line of Figure 11 is not extruded in that twisted shape. This is readily apparent

from the fact that the indentations 40 in the line are uniformly placed on each of the four perpendicularly disposed lobes along the top of each lobe. If a pre-formed, twisted, four-lobe line were passed through the perpendicularly disposed cutting wheels shown in Figure 5 of Mize, or any similar process, the indentations would appear to be applied almost randomly along the line. The indentations would not be uniform; nor would they extend only along the tops of the lobes as shown in Figure 11. The only way in which the uniform configuration of indentations shown in Figure 11 could realistically be obtained is to first indent the four-lobe line by passing the line through the cutting wheels of Figure 5 to produce the configuration of Figure 9 and then twisting the indented line in a subsequent processing step.

It is also readily apparent that the line shown in Figure 7 could not be twisted in such a secondary processing step as the strands would break apart, either during the twisting step or during subsequent use. The bond between the two adjacent strands would be structurally inadequate to hold the line together during actual use as it rotates at several thousand rpm, encountering vegetation, rocks and other debris. In fact, as noted in the supported declaration of the inventor, Richard Proulx, it is highly unlikely that the line of Figure 7 could even survive a secondary twisting step. The two strands would separate. As Mr. Proulx attests, the imminent failure of such a line would be so apparent to one skilled in the art that he or she would not attempt to twist a line, at least not without first significantly enhancing the strength of the bond between the two strands, and there

is absolutely no teaching or suggestion of how that might be achieved or even why it should be done.

It is quite clear that one would not attempt to create a noise attenuating line by twisting the line of Figure 7 based on the teachings of Mize. Mize has nothing to do with noise attenuation. The only twisting of cutting line in Mize is accomplished as a secondary process after the line has been formed and indented. Such twisting of line having the configuration shown in Figure 7 of Mize would destroy the structural integrity of the bond between the two circular strands, and in fact, create a fibrillating effect as the two strands separated – which is exactly the effect that the Mize patent seeks to avoid. This would be readily apparent to one of ordinary skill in the art. One would not look to Mize in an attempt to create or develop a noise attenuating line. Again, Mize is solely directed to the concept of indenting the line to prevent fibrillation.

The same logic applies to whether one would look to Mize to make oblately-shaped filaments twisted about its own axis. An embodiment of the present invention involves extruding molten material through a rotating die with an oblate hole, thereby creating a single strand that is slightly out-of-round (*i.e.*, slightly oblate) (see Figure 15D of the present application) and is twisted about its own central axis. This is not taught by Mize because Mize requires that the twisting be done in a secondary process. Also, the stated reason for the four-lobe structure in FIG. 9 (in Mize) to twist was to provide a multiplicity of leading edges,

thereby further contributing to a reduction in fiber fibrillation. While twisting an indented four-lobe line may cause more leading edges, it is not clear whether twisting a non-indented oblate line would achieve the same effect and there is no teaching that it would.

Thus, the cited prior art relating to flexible line and the process for forming it does not teach or suggest that molten strands can be twisted together to produce a defined product or that the product of such a process would have any utility whatsoever.

Fogle

U.S. Patent No. 6,434,837 issued to John Fogle, while not cited in the present application, was cited during the prosecution of the parent application, Serial No. 09/943,248 of which the present application is a division. The parent application, now U.S. Patent No. 6,910,277, is directed to the configuration of the noise attenuating flexible cutting line that is produced by the process recited in the claims of the present application. The Fogle patent and the remainder of the art cited during the parent application is identified on and provided with the Information Disclosure Statement filed with the present Response to Office Action.

The Fogle patent discloses a twisted trimmer line that is oblately-shaped in cross section for the purpose of noise attenuation. Fogle does not teach how his line is formed. The cross section of the Fogle line is consistently elliptical in cross section and does not define the opposed troughs in the line created by

Applicants' forming process. Accordingly, the Fogle line (like Mize) is not formed by the twisting together of molten strands by means of a rotating die as recited in the claims of the present application. Again, Fogle says nothing regarding the process by which the line is twisted. Fogle also fails to teach the tight twisted configuration of the line formed by the twisted strands that is recited in the claims. As noted earlier herein, to provide the necessary flexibility and durability in vegetation cutting line, it is necessary that the formed line, following extrusion and cooling undergo a reheating and stretching step during which the line is stretched approximately three times its original length. This is true of all extruded cutting line regardless of its shape. As a result, Applicants' process of twisting together two separate extruding molten strands allows for a tighter twist in the final product, and thus a quieter line, than could be produced by twisting a single strand about its own axis.

Thus, the Fogle patent, like Mize, does not teach or suggest that molten strands can be twisted together to produce a defined flexible line configuration or that the product of such a process would have any utility.

<u>Groff</u>

U.S. Patent No. 4,288,463 issued to Groff, unlike the above-discussed patents, is not directed to flexible vegetation cutting line or its manufacture. The Groff patent teaches a method of forming a pretzel dough by using a rotating die to twist the dough being extruded therethrough. We respectfully submit that one

skilled in the art of making flexible vegetation cutting line would not look to a patent on a pretzel forming process in order to make a noise attenuating cutting line. The art is certainly not analogous. The extrusion of pretzel dough has nothing to do with noise attenuation, nor is it relevant to extruding the molten nylon copolymer material to form lines used to cut vegetation.

As explained in the accompanying Proulx declaration, pretzel dough is very different from molten nylon and the two materials behave extremely differently upon extrusion. Pretzel dough is very viscous and will tend to hold its shape when it makes contact with a surface. The molten nylon employed in the process of the present invention is fluid and tends to flow. Pretzel dough stays at a relatively constant temperature until it is baked after extrusion. Molten nylon is in a liquid state as it passes through the die apertures and has a specific setup point at which it begins to rapidly crystallize inwardly from its outer surface. As the nylon polymers extruded and twisted into its desired shape during the process of the present application, the material passes through multiple temperature zones, including a cooling quench bath and heating oven. The interior of the strands are initially still in a liquid state when the outer crystallization begins when the strands are first twisted together above the cooling quench bath, they are both in a molten state. There is absolutely nothing in the Groff reference that teaches or suggests how such a material could be joined together and twisted to form a specific shape. There is also no teaching in Groff why one would want to form such a shape

from molten nylon. As explained by Mr. Proulx, there is nothing in the cited Groff reference that suggests how to handle molten nylon or that such material could be extruded through two adjacent openings and twisted together as claimed. In view of the differences between the material, Proulx stated that as one skilled in the art he would not look to a patent dealing with pretzel dough to teach him how to handle and extrude a molten nylon material into a desired configuration. There is also no teaching in Groff that would suggest that molten nylon material or, for that matter, any material, could be extruded through a die rotating at speeds of 750 to 2500 rpm to provide the desired tight twist in the line. Of course, there is also nothing in the cited art to suggest why one would want to form such a tight twist in the line.

In conclusion, there is no teaching in the prior art that two strands twisted together can provide a noise attenuating line or that two strands of a plastic-like material of which flexible cutting line is formed can be twisted together in a molten state during extrusion to form any identifiable shape. Absent such teaching there is no reason one would rotate an extrusion die during a line forming process.

Neither Mize nor Fogle teaches that one can obtain noise attenuation by joining together two separate strands, nor does any other prior art of which Applicant is aware. There is nothing in Proulx '462, Mize, Fogle or Groff to suggest that a molten nylon polymer or copolymer can be extruded as claimed. As stated by Proulx in his declaration, because of the differences in the materials, and the ways

in which they reach during extrusion, the behavior of extruding pretzel dough is totally unrelated to the extrusion of the molten material of which Applicants' line is formed. Further, there is no teaching in Groff that two strands of a molten polymer or copolymer or even pretzel dough could be twisted as tightly as is necessary to effect noise attenuation. As a result, one skilled in the art of manufacturing flexible trimmer line would not consider Groff. Even if they did, neither Groff nor the cited Proulx patent would teach one how to handle the extruded twisted line so as to (1) avoid the formation of a severable weld between the two strands which was the intent of the process in the earlier Proulx patent; and (2) allow the two strands to fuse permanently together yet retain the desired noise attenuating shape (a shape also not found in the prior art).

Finally, Claims 3-5, 7-9, 12-14, 17, 21-23 and 25-27 all recited either the rapid rate of rotation of Applicants' die and/or the high number of twists in the formed line per linear foot, both of which are far greater than what is disclosed in the Groff pretzel forming process and neither of which are suggested by Groff or other prior art. Certainly, these die rotation rates and the number of twists per foot in the formed line are not merely matters of designer's choice as prior to the present invention no such product was ever formed with the claimed process, and certainly it would not be possible to twist pretzel dough as tightly as claimed.

PATENT

For all of the reasons set forth above, it is respectfully submitted that each of the claims in the application clearly defines patentable subject matter over the art of record. Applicant has developed a novel method for manufacturing a cutting line configuration which represents a substantial advancement in this art. It is therefore respectfully requested that each of these claims be allowed and the application passed to issue.

Respectfully submitted,

HOLLAND & KNIGHT LLP

Dated: Sept. 22, 2005

By

Richard E. Lyon, Jr.
Registration No. 26,300
Attorneys for Applicant

633 West Fifth Street, 21st Floor
Los Angeles, California 90071-2040
Telephone: (213) 896-2400
Facsimile: (213) 896-2450
E-mail: PTdocketing@hklaw.com
Customer No. 34261

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